

## Plurality in environmental supply chain mechanisms: differential effects on triple bottom line outcomes

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# **Plurality in environmental supply chain mechanisms: Differential effects on triple bottom line outcomes**

## **INTRODUCTION**

Buying firms are being increasingly confronted with alarming incidents of non-compliance with respect to sustainability along their upstream supply chains (e.g., Wilhelm et al., 2016); these incidents have continually harmed the performance of the buying firm (Hartmann and Moeller, 2014). Among others, the suppliers of McDonald's were not only criticized, but even fined by the Chinese government for water and environmental pollution (Hewitt, 2015; Mozur, 2013). Accordingly, buying firms are mandated to take substantial measures to prevent these looming sustainability concerns in their upstream supply chains through adequate management of suppliers' environmental practices (e.g., Blome et al., 2014a; Paulraj, 2011; Reuter et al., 2010); this is clearly evident in very recent changes of environmental supply chain mechanisms of firms like Apple (Vaughan, 2016) and Ford (Hardcastle, 2015). Research has closely analyzed the different mechanisms that are adopted by firms to encourage as well as manage the environmental practices in supplier firms (e.g., Blome et al., 2014b; Gimenez and Sierra, 2013; Paulraj, 2011; Paulraj et al., 2014; Tachizawa et al., 2012; Vachon and Klassen, 2006). This literature broadly characterizes environmentally-oriented supply chain mechanisms into two broad categories: environmental collaboration (EC) and environmental evaluation (EE). EC is a relational mechanism (Macneil, 1980) as it represents a soft and trust based approach in achieving improved performance, while EE is a transactional mechanism (Williamson, 1985) as it focuses on a hard, fact-based analysis of performance that might also lead to improved performance.

Following the notions of plurality introduced by Cannon et al. (2000) and Poppo and Zenger (2002), extant supply chain management research has acknowledged the fact that both

these mechanisms can have a complementary effect (e.g., Gimenez and Sierra, 2013; Krause et al., 2000; Lee and Klassen, 2008; Rao, 2002; Reuter et al., 2010; Vachon and Klassen, 2006; Tachizawa et al., 2012). With the exception of the works of Gimenez and Sierra (2013) and Tachizawa et al. (2012), empirical evidence on the complementary effects has been predominantly based on the case study approach. More importantly, as opposed to complementary effects, management scholars also suggest that too much evaluation could drive out collaboration in a buyer-supplier relationship (e.g., Ghoshal and Moran, 1996; Woolthuis et al., 2005) or higher-levels of collaboration might actually make evaluation unnecessary (e.g., Cannon et al., 2000). So, could EC and EE substitute for each other instead? Unfortunately, extant research does not explicitly test for this substitutionary effect. But this is a very important question for managers, especially in times when the business case for environmental sustainability is still actively debated (Kiron et al., 2012). If EC and EE are substitutable, then managers could actually achieve higher levels of performance without sacrificing additional resources. Currently, firms use a mix of EC and EE mechanisms. For example, Ford shares best environmental practices with its suppliers in a collaborative fashion while it simultaneously audits its suppliers (Hardcastle, 2015), without potentially knowing the benefits of these different mechanisms.

On a related note, when it comes to the performance impacts of the plural forms of environmental supply chain mechanisms, empirical research focuses only on environmental performance (e.g., Gimenez and Sierra, 2013; Tachizawa et al., 2012). But considering all aspects of the triple bottom line performance is of equal managerial importance as it could help unearth the differential performance effects of the plural forms of EC and EE. Specifically, firms and managers are nowadays asked by stakeholders to measure all dimensions of the triple bottom line so as to show a balanced performance (Painter-Morland, 2006). Against this backdrop, the research question driving this research effort is “whether (or how) EC and EE could be used in

conjunction to better impact the focal firm's triple bottom line performance". Given that relational exchange theory (RET) and transaction cost economics (TCE) can both inform different aspects revolving around the simultaneous pursuit of EC and EE, we draw upon these theoretical perspectives to ground our hypotheses.

In following through with the stated research goal, our study makes several compelling contributions. First, we extend current research by documenting the intricacies in the plural forms of environmental supply chain mechanisms, thereby providing support for both complementarity as well as substitutability that is inherent in these mechanisms (Denison et al., 1995). This is also valuable to managers as conflicting mechanisms could be avoided or resources could be saved due to the complementary nature of mechanisms. Second, as pointed out earlier, empirical research on the complementarity between EC and EE includes only environmental performance. But as evident from our results, it is important to augment current research as well as managerial insights by including all aspects of the triple bottom line (i.e., economic, environmental, and social measures). Specifically, our results suggest that the simultaneous presence of EC and EE can have significantly intriguing effects on economic, environmental and social performance. In general, no matter the outcome variable, our results clearly show that EC and EE could act as complements when they both are maintained at relatively the same level. On the other hand, when EC and EE are maintained at dissimilar levels, their effects are unique for different outcome measures. Specifically, when considering economic performance, our results suggest that high levels of either transactional or relational mechanisms could hurt the generation of relational rents only in a purely economic sense. Alternatively, while considering firm's environmental and social performance measures, high levels of EC do not have a detrimental effect on the outcome variables. These findings clearly document that the nature of plurality in EC and EE depends very much on the triple bottom line outcome measure being considered. These insights carry significant weight for

practicing managers. In general, it seems preferable to balance EC and EE; but if exceptional environmental and social performance is targeted, then firms might risk economic benefits. Thus it is up to the manager to identify the most important strategic priority of the firm and then pursue EE and EC at appropriate levels as identified in our findings.

The rest of the paper is structured as follows. First, we discuss the theoretical background of the study, specifically exploring transactional and relational mechanisms as well as their plural forms. Next, we provide the theoretical underpinning of the hypotheses that will be tested. Subsequently, we explain the methodology adopted to answer the proposed hypotheses. The final section presents not only the discussion of our observations along with their theoretical and managerial implications, but also the limitations of our study and future research opportunities.

## **THEORETICAL DEVELOPMENT**

### **Environmental Supply Chain Mechanisms**

Supply chain mechanisms help firms to address safeguarding, cooperation, and coordination in buyer-supplier relationships. Extant research suggests that the management of these relationships can consist of different “building blocks” stemming from markets, hierarchies, and partnerships (Cannon et al., 2000). Specifically, extant research distinguishes between two broad forms of mechanisms – transactional and relational (Heide, 1994; Poppo and Zenger, 2002; Liu et al., 2009). Along a similar vein, we follow Vachon and Klassen (2006) and propose two mechanisms – EC and EE – that are prevalent in managing environmental practices of the suppliers. Specifically, we envision them to reflect “actual operative practice[s], which are brought to bear between two parties” (Hoetker and Mellewigt, 2009, p. 1027).

**Transactional Mechanisms.** Transactional mechanisms originate from economics literature that uses TCE as its guiding theoretical framework. Following the tenets of TCE,

transactional mechanisms consider supplier relationships as discrete transactions and manage them with the ambition of curbing opportunistic behavior (Williamson, 1985). These activities are control-based in that they focus purely on influencing exchange partners' action through contracts and/or monitoring (Genctürk and Aulakh, 2007). Though a variety of transactional mechanisms exist, scholars have predominantly focused on the existence of formal contracts (Lusch and Brown, 1996). Alternatively, with the understanding that contracts alone do not suffice for ensuring compliance, other transactional mechanisms have also been highlighted. For example, Hoetker and Mellewigt (2009) show that monitoring can also help in better coordinating supply chain activities. Liu et al. (2009) justify the appropriateness of legal stipulation and incentive systems.

Contracts are ex-ante measures to reduce uncertainty; however, in the case of environmental management, contracts are less effective given the lack of well-formed objectives and the issue of performance ambiguity makes ex-post evaluation of contractual compliance difficult (Alchian and Demsetz, 1972). Thus, instead of focusing on ex-ante measures like contracts, we believe that EE, an important measure of environmental processes, can better capture transactional mechanisms in use. Following Vachon and Klassen, (2006), we conceptualize EE to involve monitoring and assessment that is focused on gathering and processing environmentally-oriented information. Additionally, our conceptualization of EE signifies the use of arms-length mechanisms that focus mainly on controlling the outcome of the suppliers' environmental efforts.

**Relational Mechanisms.** Relational mechanisms originate from the relationship literature that is modelled after RET. So, these mechanisms take historical and social context into account when managing buyer-supplier relationships (Macneil, 1980; Heide, 1994). Unlike transactional mechanisms, relational mechanisms are based on moral norms that emerge from expected behaviors of the exchange partners as well as their internalized values (Bensaou and Venkatraman, 1995; Genctürk and Aulakh, 2007; Liu et al., 2009). As these mechanisms are social in nature, they

thrive on open communication, trust, solidarity, social identification, and joint cooperation (Heide and John, 1992; Hoetker and Mellewigt, 2009). Accordingly, such norm-based mechanisms can help in developing relation-specific assets, knowledge-sharing routines, as well as complementary resources (Dyer and Singh, 1998).

In line with the norms of RET, we follow Vachon and Klassen (2006) and conceptualize EC to reflect the direct involvement of the buying firm in planning and managing the environmental capabilities of the supplier. Unlike EE, the focus is on collaboration wherein the supply partners work together to not only reduce the environmental impact of their combined products and processes, but also to enhance the overall environmental prowess of the supplier firm (Bowen et al., 2001; Gimenez and Sierra, 2013). It also signifies the willingness of the partner firms to commit financial as well as non-financial resources to address their combined environmental goals (Paulraj, 2011). Accordingly, given that EC refers to the extent to which the partners work together to achieve mutual environmental goals, it is clearly a relational mechanism that could facilitate a good understanding of the complementarities that exist among the capabilities of the partner firms.

### **Plural View of Relational and Transactional Mechanisms**

Historically, relational and transactional mechanisms were generally considered to be at the two ends of a continuum. Some researchers suggest that the existence of one mechanism may in fact prevent the adoption of another (Larson, 1992; Gulati, 1995); i.e., the existence of a monitoring mindset may deter the development of relational norms in the relationship (e.g., Ghoshal and Moran, 1996; Woolthuis et al., 2005); close cooperation between exchange partners might make transactional mechanisms like monitoring unnecessary (e.g., Gulati, 1995; Dyer and Singh, 1998; Cannon et al., 2000). On the other hand, proponents espousing the pluralistic view have shown that a combination of transactional and relational mechanisms might actually be beneficial. For

example, Poppo and Zenger (2002) and Zaheer and Venkatraman (1995) have empirically established that performance improvements could be significantly higher when both transactional and relational mechanisms were used jointly than when they were used in isolation. Similar effects have been documented by other scholars including Cannon et al. (2000), Liu et al. (2009), and Li et al. (2010). In summary, organizational scholars generally acknowledge the plurality of these mechanisms.

But apart from case study evidences that environmental supply chain mechanisms (EC and EE) could act in a synergistic manner (e.g., Lee and Klassen, 2008; Reuter et al., 2010), the testing of a pluralist view of EC and EE is still nascent with two laudable exceptions. Following the synergistic effect proposed by Lee and Klassen (2008), Tachizawa et al. (2012) were among the first to empirically study plural environmental supply chain mechanisms. Based on a sample of Spanish firms, they explore different clusters of environmental strategies, namely high collaboration / high evaluation, high evaluation / low collaboration and low collaboration / low evaluation. Based on ANOVA, they provide evidence that different strategies are not only possible, but could also have differential effect on environmental performance. But interestingly, they did not include a high collaboration / low evaluation configuration in their analysis. Gimenez and Sierra (2013) extend this research by investigating the links of collaboration and evaluation on environmental performance. Besides other results, using a sample of Spanish and German firms as well as the ANOVA methodology, the authors find support for the fact that there are not only different configurations (i.e., plural forms) of collaboration and evaluation, but also higher levels of collaboration and assessment is linked to higher levels of environmental performance.

Both these studies provide important insights into the fact that different combinations of EC and EE can have differential impact on environmental performance. However, what is missing is an empirical enquiry into the impact on the economic and social dimensions of triple bottom line



performance. Additionally, it is also important to conduct a more nuanced investigation on whether these mechanisms could act as complements and/or substitutes. Such an enquiry needs a more robust methodology than ANOVA. Specifically, organizational scholars suggest that the polynomial regression approach is a simple, yet, robust methodology when testing for congruence – i.e., complementarity and/or substitutability (e.g., Edwards, 2001; Meilich, 2006). Accordingly, we use polynomial regression analysis along with response surface methodology to gain a fine-grained understanding of the effect of plural forms of EC and EE on triple bottom line performance.

### **HYPOTHESIS DEVELOPMENT**

Since we study plural forms of EC and EE, our hypotheses focus on interaction effects. But our view of interaction does not follow the traditional contingency approach which allows only for multiplicative effects; while this approach could help us to study complementary effects, it does not specifically assess for substitutionary effects. Therefore, we use the polynomial regression analysis as this allows us to model both interaction and curvilinear effects; this approach helps us to better understand whether these mechanisms act as complements or supplements through the evaluation of a three-dimensional surface map (Please refer to Edwards (1994) and Lambert et al. (2003) for a detailed review). We hypothesize along the symmetry as well as the asymmetry lines of the response surface (Please refer to Figure 1); while the symmetry line reflects the simultaneous increase in EC and EE, the asymmetry line reflects the increase in EC and the simultaneous decrease in EE. Additionally, we concentrate on the beginning, middle, and end points along the symmetry and asymmetry lines with the ambition of presenting the theoretical justification for our hypotheses clearly.

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Insert Figure 1 about here  
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## **Economic Performance**

We propose that economic performance will be rather low when both EC and EE are low because the buying firm will have minimal knowledge about the environmental prowess of the supplier firm. As advocated by both TCE and RET, EC and EE in such cases will not be mature enough for the focal firm to understand the supplier processes, their environmental capabilities, as well as the problems that could exist within the supplier organization (e.g., Williamson, 1991; Heide and John, 1992; Genctürk and Aulakh, 2007). According to TCE, the level of opportunism is bound to be high in such relationships and the supplier's environmental behavior could have a detrimental effect on the buyer's performance, thereby resulting in higher governance cost. Alternatively, as per RET, relatively low levels of collaboration will limit mutual benefits as both partners will not invest intensely in their relationship.

On the other hand, at medium and high levels of EC and EE, economic performance will be at a medium and high level respectively. The underlying logic is that by exercising higher levels of EC and EE the buying firm will be able to develop a greater understanding of the supplier processes. This would entail the buying firm to regularly monitor supplier operations, exchange information, and jointly work on environmental innovations. As these relationships extend over a longer period of time, the partners will learn each other's behavior, gain a clear understanding of the synergies that exist between their processes, and treat their counterpart equally well so as to sustain the relationship (Chen et al., 2004; Zollo et al., 2002). Relational norms will also help in avoiding performance-destroying opportunism (e.g., Heide and John, 1992; Macneil, 1980). The simultaneous presence of EE along with EC would signal that the buyer side is not only acting in self-interest, but is also interested in nurturing the overall relationship with the supplier. More importantly, monitoring activities could also serve as a "safety-net" if in case relational mechanisms, as advocated by TCE, give way to opportunism (Ring and Van de Ven, 1994).

Therefore, though EE is a transactional mechanism, when taken together with EC, it would rather serve as a cross-checking mechanism that can not only help in the identification of problem areas within the supplier firm, but also in subsequent resolutions through effective future collaboration. In summary, we propose that EC and EE could act as complements when it comes to economic performance. Therefore,

*H<sub>1a</sub>: EC and EE will have a complementary effect on economic performance. In other words, there will be a linear effect on the symmetry line.*

When considering the asymmetry line, we propose that economic performance will suffer if there is an imbalance in the level of EC and EE. In other words, we propose that these mechanisms cannot substitute for each other and that the mid-levels of EC and EE will result in the best economic performance along the asymmetry line (as the mid-point reflects complementarity and moving further away from it suggests substitutionary effect). From the purely economic sense, high level of EC comes at a considerable cost as it signifies direct involvement as well as investment of resources from the buying firm (Larson, 1992; Klassen and Vachon, 2003; Vachon and Klassen, 2006). In other words, working jointly on environmental innovations would require more time, effort, and resources from the buying firm. Additionally, blindly trusting as well as investing in partners, without extensive evaluative mechanisms to ensure satisfactory performance, could in itself be a source of opportunism (Cannon et al., 2000). If the suppliers detect that the buying firm does not “care” about their output, they might rather be motivated to act opportunistically by cutting corners (Williamson, 1985). For example, if the buying firm requires the supplier to pursue environmental-friendly procedures but never checks or audits the supplier’s operations, then the supplier might perceive that compliance is unimportant and might opportunistically signal its compliance without implementing required practices. Therefore, partners should also pay attention to the performance of the supplier to improve the

environmentally-oriented performance of the relationship as well as value the supplier's efforts. Similarly, a relatively high level of EE with rather low levels of EC will not only result in a lack of trust, but will also dissipate the relational rents that could be gained through the relationship. Additionally, when transactional mechanisms are implemented on a high level, they might hamper the performance of the relationship, as intense monitoring comes at a cost for both parties. Thus,

*H<sub>1b</sub>: EC and EE will not function as substitutes in explaining economic performance. In other words, there will be an inverted U-shaped curvature on the asymmetry line.*

### **Environmental and Social Performance**

When EC and EE are focused on environmental management, they could lead to improved environmental and social performance as well. Therefore, the arguments for economic performance can also be applied within environmental and social performance context as the simultaneous adoption of control and collaboration can help minimizing the likelihood of opportunism in environmental issues. Furthermore, environmental and social performance will improve if firms jointly innovate environmentally-friendly products, streamline their processes to avoid waste, and jointly manage product and process safety (Dyer and Singh, 1998; Paulraj, 2011). By simultaneously collaborating on environmental issues and evaluating supplier environmental practices, both firms can benefit by identifying and honing the complementary environmentally-oriented resources that exist in the relationship. Moreover, the elevated level of trust inherent in relationships signified by relatively high EC can alter supplier perceptions and dissipate the negative effects of the transactional mechanisms in play (Frey, 1997). The supplier would thus consider these controls mechanisms as positive reinforcements given their ability to not only resolve problem areas through further collaboration, but also to establish a basis for the development of future shared environmental expectations (e.g., Cannon et al., 2000). Accordingly,

we hypothesize that low, medium, and high levels of EC and EE could result in corresponding levels of environmental and social performance along the symmetry line.

*H<sub>2a</sub>: EC and EE will have a complementary effect on environmental performance. In other words, there will be a linear effect on the symmetry line.*

*H<sub>2b</sub>: EC and EE will have a complementary effect on social performance. In other words, there will be a linear effect on the symmetry line.*

Unlike economic performance, we believe to see different effects along the asymmetry line for environmental and social performance. The resources to govern the relationship are included as management costs only in an economic sense. Therefore, pursuing higher levels of either EE or EC might have a beneficial effect from an environmental and social performance point of view. We contend that environmental and social performance will be at a higher level when either EE is high and EC is low or EE is low and EC is high, since behavioural uncertainty is comparably high in the environmental and social performance domain as performance measures are more difficult to quantify and measure when compared to the economic domain. In other words, we propose that EE and EC can substitute for each other in impacting environmental and social performance. Therefore, it might be beneficial in pursuing more extreme environmental supply chain mechanisms – whether transactional or relational (e.g., Gundlach and Murphy, 1993; Rindfleisch and Heide, 1997). For example, as advocated by TCE, it is necessary to pursue intense monitoring as only this would guarantee that the supplier is not behaving opportunistically and is putting every effort to satisfy the environmental requirements of the focal firm (Williamson, 1985). Similarly, in the case of increased EC, trust between partners will increase, thereby enabling them to enhance their capabilities, rectify their limitations, and minimize the detrimental effects of behavioral uncertainty (Dyer and Singh, 1998; Paulraj, 2011).

On the contrary, when EC and EE are at moderate levels, the supplier will be uncertain about the intentions of the focal firm and rather view the relationship as characterized by mixed signals (e.g., Ghoshal and Moran, 1996). Accordingly, moderate levels of these mechanisms will impose a psychological barrier that will distance the partner firms, whereby the supplier will be reluctant to participate in the environmental initiatives as well as share knowledge, resources, and capabilities that could significantly augment the environmental and social performance of the focal firm (Granovetter, 1985). Therefore,

*H<sub>2c</sub>: EC and EE will function as substitutes in explaining environmental performance. In other words, there will be a U-shaped curvature on the asymmetry line.*

*H<sub>2d</sub>: EC and EE will function as substitutes in explaining social performance. In other words, there will be a U-shaped curvature on the asymmetry line.*

## METHODOLOGY

### Data Collection

Data for this study was collected from high-ranking purchasing/supply chain executives. The initial sample of 2,500 members was obtained from the Institute for Supply Management (ISM). This list covered manufacturing firms representing the SIC codes 20, 23, 25, 28, 29, 35, 36, 37, and 39. All indicators were measured using a 7-point Likert scale. Indicators representing EC and EE were captured using end points of *strongly disagree* and *strongly agree*; indicators measuring performance were captured using end points of *decreased significantly* and *increased significantly* as they were assessed based on the change in performance in the last two/ three years. The respondents were advised to answer supplier-related indicators based on their top key suppliers that were selected based on the dollar amount of purchase and/or the importance of materials purchased.

Data was collected in two stages – first step involved the mail survey approach while the second step involved the web survey approach. The mail survey approach adopted a modified version of Dillman’s total design method (Dillman, 2007). The survey was sent to a randomly selected list of 1,000 respondents. While 38 surveys were returned undelivered, 26 of the potential respondents replied stating that they could not participate in the study due to company policy, lack of experience, etc. This reduced the effective sample size to 936 participants. From this list, 114 responses were received (12.2% response rate). We discarded 12 responses due to incompleteness, thereby reducing the usable sample size to 102 (i.e., effective response rate = 10.9%). As indicated earlier, the second stage involved the web survey approach. Since email addresses of the potential respondents were not provided by ISM, the web survey approach included two steps. A total of 466 respondents were selected randomly from the remaining list of 1,500 respondents (as 1,000 was selected for the mail survey). These respondents were sent a cover letter explaining the research project along with a consent form to notify their willingness to participate in the study. Forty seven consent forms were found undeliverable and were returned back. From the remaining 419 potential respondents, 125 returned their consent forms, with 59 of them consenting to participate. A link to the web-survey was emailed to these 59 participants; a total of 44 completed the web survey. After discarding 1 response due to incompleteness, we ended up with a usable sample of 43 in this stage of data collection (i.e., response rate = 12.18%). The final usable sample was 145 (final response rate of 11.25%). The final sample included a total of 136 high-ranking purchasing executives (i.e., president, vice president, director, and purchasing manager). The respondents also had an average experience of 5.8 years in environmental initiatives.

## **Measures**

*EC* includes indicators focusing on the firm’s willingness to not only cooperate with their suppliers, but also provide them with required resources to achieve their environmental objectives

(Bowen et al., 2001; Zhu and Sarkis, 2004; Vachon and Klassen, 2006). *EE* included items focusing on the firm's ambition to monitor the environmental impact of suppliers' internal products as well as processes (Walton et al., 1998; Bowen et al., 2001; Zhu and Sarkis, 2004; Vachon and Klassen, 2006). *Economic Performance* is measured by indicators covering improvements along cost and other financial measures (Menguc and Ozanne, 2005). Finally, *environmental performance* focused on improvements in emission and waste, usage of environmentally-safe materials, and energy savings (Zhu and Sarkis, 2004) and *social performance* focused on improvements along health and safety of not only the employees of the firm, but also its broader community (Bansal, 2005). In addition, we controlled for the performance impact of firm size using number of employees and annual sales volume (Paulraj et al., 2008). We also controlled for industry effects. Since SIC codes of 23, 25, and 29 were represented by less than or equal to 2 responses, we created dummy variables for all other SIC codes (20, 28, 35, 36, 37, and 39).

### **Non-response and Common Method Bias**

In order to test for non-response, we randomly selected 250 companies from the list of non-respondents and gathered information on number of employees and annual sales volume from secondary data sources (Chen and Paulraj, 2004). The mean for the population was determined by combining the information of these 250 companies with the final sample of 145 firms. Comparison of demographic variables between the sample (i.e., 145) with this mean for the combined list of responding and 250 non-responding firms suggests that there are no statistically significant differences (at  $p < 0.01$ ), suggesting that non-response bias is not a major issue. Additionally, we also conducted tests to determine whether the industry distribution (i.e., SIC codes) was similar among respondents and non-respondents. The chi-square test including the entire sample suggests that there is no significant difference among the two groups.



We assessed common method bias using the marker variable technique (Malhotra et al., 2006). According to this technique, the second-smallest positive correlation among the indicators was considered as the marker variable. Subsequently, the correlation coefficient of the marker variable was used to adjust the zero order, statistically significant, correlations among all indicators. After this procedure, we found all zero order correlations to be statistically significant. Additionally, the maximum difference between the zero-order and the adjusted correlations was only 0.006, suggesting that CMB is not a major concern.

### **Instrument Development**

Before evaluating the reliability and validity of the measurement items, the indicators were tested for the existence of outliers, and normality. Content validity of the instrument was established by pre-testing the instrument using researchers and practitioners. Five researchers as well as six senior purchasing executives reviewed the structure and the completeness of the survey (Dillman, 2007). We made minor modifications to the final instrument based on the suggestions made by these experts. Construct validity and unidimensionality were assessed using confirmatory factor analyses (CFA). Since different scale end points were used for performance and non-performance indicators, we assessed two different measurement models. The model fit indices provided in Tables 1 and 2 illustrate that the model fits the data well and hence establishes unidimensionality. The path coefficients of all indicators were found to be significant. Two indicators were deleted during these analyses.

Discriminant validity was established using the average variance extracted (AVE) values of the constructs (Fornell and Larcker, 1981). According to this test, constructs are discriminant if the squared correlation between each pair of constructs is less than the AVE of each those construct. As evident in Table 3, the square root of the AVE value for each individual construct was found to be lower than the respective correlations, thereby establishing discriminant validity. Cronbach's

alpha as well as composite reliability (CR) values were used to establish reliability. As given in Tables 1 and 2, Cronbach's alpha as well as CR values for all constructs were greater than 0.70, thereby ensuring that all theoretical constructs were reliable. In addition, all constructs except economic performance had AVE values that exceeded the threshold of 0.50. Even though the AVE value for economic performance surpassed this cutoff by deleting the third indicator ("decrease in fee for waste discharge"), we retained it due to the belief that it is a key economic aspect when focusing on environmental practices. In summary, the measurement instrument development process clearly shows that the theoretical constructs are reliable, valid, as well as unidimensional.

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Insert Tables 1, 2, and 3 about here  
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## **Hypothesis Testing**

The summary statistics as well as the correlation matrix are provided in Table 3. Given that we hypothesize linear as well as curvilinear relationships between the theoretical constructs, a polynomial regression analysis that includes interaction as well as curvilinear effects was used. The scores for EC and EE were centered by subtracting the scale mid-point before creating the curvilinear and interaction terms, resulting in scores that range from -3 to +3. All variance inflation factor values were lower than 3, thereby confirming the absence of multicollinearity.

Apart from testing the significance of the coefficients of EC and EE, we were also interested in investigating the significance of slopes and curvatures (i.e., for the response surfaces) that were generated by the polynomial regression analyses. We have provided a brief overview of the steps involved in deriving the slope and curvature of a response surface (these steps are similar to the approach adopted by Lado et al., (2008)). For a detailed description of this procedure, please refer to the works of Edwards and his colleagues (Edwards and Parry, 1993; Edwards, 1994;

Lambert et al., 2003). Generally, the following quadratic equation is required to study response surfaces using polynomial regression:

$$Z = b_0 + b_1 EC + b_2 EE + b_3 EC^2 + b_4 EC * EE + b_5 EE^2 + e \quad (1)$$

In this equation, Z represents the outcome (performance) variable. The coefficients ( $b_1$  through  $b_5$ ) refer to the unstandardized coefficients. Finally, e in the above equation represents the random disturbance term<sup>1</sup>. Our hypotheses do not focus on these coefficients directly. Instead, they relate to the slopes and curvatures of the surface along two lines ‘EE = EC’ and ‘EE = -EC’, referred to as the symmetry and asymmetry lines respectively (Edwards and Parry, 1993; Lambert et al., 2003). The symmetry line includes points where both EC and EE are same in terms of value and sign; the asymmetry line includes points where EC and EE are same in terms value, but not in terms of sign. To derive the surface along the symmetry and asymmetry line (as given in the following equations), we substitute EE = EC for the symmetry line and EE = -EC for asymmetry line in Equation 1:

$$Z = b_0 + (b_1 + b_2) EC + (b_3 + b_4 + b_5) EC^2 + e \quad (2)$$

$$Z = b_0 + (b_1 - b_2) EC + (b_3 - b_4 + b_5) EC^2 + e \quad (3)$$

In the above equations, ( $b_1 + b_2$ ) and ( $b_1 - b_2$ ) represent the slopes along the symmetry and asymmetry lines respectively, while ( $b_3 + b_4 + b_5$ ) and ( $b_3 - b_4 + b_5$ ) represent the curvatures along the symmetry and asymmetry lines respectively. Now, to test the joint effect of EC and EE on the outcome variables, we evaluated these slopes and curvatures (Edwards and Parry, 1993). We did not find any of the dummy variables to be significant in the models evaluated. Accordingly, we

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<sup>1</sup> For all three polynomial regressions involving economic, environmental, and social performance, we checked to ensure that the disturbance terms (residuals) satisfied the assumptions of normality and heteroscedasticity. We used the univariate skewness and kurtosis statistics of the residuals to assess normality. The maximum absolute values of skewness and kurtosis of the residuals were 0.57 and 0.77 respectively. These values are well within the limits recommended by Curran et al. (1996) – skewness  $\leq 2$  and kurtosis  $\leq 7$ . We tested heteroscedasticity using the White’s general test (White, 1980). The tests for all three polynomial regression models were insignificant at 95% significance level, suggesting that there is no evidence of heteroscedasticity.

removed the control variables and solved the polynomial regression models to arrive at the final results with the belief that it will help us to derive response surfaces that truly reflect the joint effects of EC and EE.

## **Results**

Hypothesis 1 focused on the joint effects of EC and EE on economic performance. More specifically, since hypothesis H<sub>1a</sub> tests for the complementary effect of EC and EE, it predicted a linear effect along the symmetry line (i.e., significant positive slope and insignificant curvature). The results in Table 4 show that the slope ( $b_1 + b_2$ ) of the symmetry line is significant (0.324;  $p < 0.01$ ), while the curvature ( $b_3 + b_4 + b_5$ ) was not (-0.013; ns). Thus, as EC and EE increased, economic performance continued to increase up to a certain level after which it starts to slightly diminish (though the curvature is not significant). In general, these results provide support for Hypothesis H<sub>1a</sub>, suggesting that there is complementarity between EC and EE when it comes to economic performance. On the other hand, hypothesis H<sub>1b</sub> predicted EC and EE cannot substitute for each other (i.e., an inverted U-shaped curvature – insignificant slope and significant negative curvature). The slope ( $b_1 - b_2$ ) along the asymmetry line was found to be negative and insignificant (-0.076; ns), while the curvature ( $b_3 - b_4 + b_5$ ) was found to be negative and significant (-0.361;  $p < 0.05$ ). The sign and significance of the curvature clearly suggests that there is an inverted U-shape along the asymmetry line; thereby providing sufficient support for hypothesis H<sub>1b</sub>. In general, this result suggests that EC and EE cannot function as substitutes within the context of economic performance. More interestingly, the result along the asymmetry line provides additional support to the notion of “alignment” or “complements”, in that at extreme levels of mismatch (misalignment) between EC and EE, economic performance seems to be worse; while at higher levels of alignment between EC and EE (i.e., towards the center of the asymmetry line), economic performance seems

to be greatly improved. Figure 2 presents the surface for these hypotheses from two different angles (for better clarity).

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Insert Table 4 and Figure 2 about here  
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Hypothesis 2 focused on the joint effects of EC and EE on a) environmental and b) social performance. H<sub>2a</sub> predicted that EC and EE will have a complementary effect on environmental performance (i.e., significant positive slope and insignificant curvature) and H<sub>2b</sub> predicted the same for social performance. Table 4 shows that all coefficients, except EC, were insignificant. In addition, while the symmetry line's slope was significant for environmental performance (0.530;  $p < 0.01$ ) and social performance (0.429;  $p < 0.01$ ), the curvature for both environmental performance (-0.015; ns) and social performance (0.011; ns) were not. These results provide support for Hypothesis H<sub>2a</sub> and H<sub>2b</sub>. On the other hand, hypothesis H<sub>2c</sub> and H<sub>2d</sub> predicted that EC and EE will function as substitutes in the case of environmental and social performance (i.e., a U-shaped curvature – insignificant slope and significant positive curvature). The slope along the asymmetry line was found to be marginally significant for environmental performance (0.320;  $p < 0.10$ ) and insignificant for social performance (0.267; ns) for social performance. The curvature was not significant for both environmental performance (0.207; ns) and social performance (0.009; ns). Though in the expected direction (i.e., positive), given that the curvatures were not significant, hypothesis H<sub>2c</sub> and H<sub>2d</sub> were not supported. The response surface for these hypotheses is presented in Figures 3 and 4.

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Insert Figures 3 and 4 about here  
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## **DISCUSSION AND CONCLUSION**

### **Discussion of Results and Theoretical Implications**

Past studies that focus on both EC and EE explore their direct effects on environmentally-oriented practices. While such an enquiry has helped us gain useful insights into environmentally-oriented supply chain management, they do tremendous disservice to managers functioning in today's complex organizations (Lewis, 2000). Therefore, only research efforts that accept as well as test for the plurality of these supply chain mechanisms could help unfold the practical issues revolving around them. Accordingly, we build upon the works of Tachizawa et al. (2012) and Gimenez and Sierra (2013) and explore the joint effects of EC and EE on triple bottom line performance. More specifically, by using RET and TCE in conjunction, we aspire to increase our knowledge about these environmental supply chain mechanisms.

In general, no matter the outcome variable, our results follow extant research (e.g., Gimenez and Sierra, 2013; Lee and Klassen, 2008; Reuter et al., 2010; Tachizawa et al., 2012) and show that EC and EE could act as complements when they both are maintained at relatively the same level (i.e., along the symmetry line). In other words, higher levels of transactional mechanisms (EE) need not be detrimental to environmental and social performance of the focal firm as far as relational mechanisms (EC) are also maintained at the same level. The logical assumption that elaborate use of monitoring mechanisms might convey mixed messages, thereby leading the supply partner to not open up as well as stifle joint opportunities seems to be a fallacy. Alternatively, following the "trust-but-verify" approach advocated by Lewicki et al. (1998), it would rather be beneficial for the focal firm to adopt a "collaborate-and-evaluate" approach within the environmental context. In other words, while high level of relational mechanisms enables the development of self-enforcing behavior that personifies trust and commitment (Dyer and Singh, 1998), the transactional mechanisms might serve in a reinforcing role to enrich the exchange relationship between the partners (Lado et al., 2008). More specifically, when taken together with EC, EE could not only serve as a cross-checking mechanism that can help in the identification as

well as a smooth resolution of environmental problems, but also as a litmus test of past collaborative efforts that could enable more in-depth and focused future collaboration between the partners, thereby enhancing the strategic synchronization of inter-organizational environmental practices. In addition to providing fine-grained support for the findings of Tachizawa et al. (2012) and Gimenez and Sierra (2013) with respect to environmental performance, our study also empirically establishes that similar complementary effects could be realizable in the case of economic and social performance measures as well.

On the other hand, when looking along the asymmetry line, our results show that the effects of EC and EE are unique for different triple bottom line outcome measures; this finding presents new insights, over and beyond extant literature, on the plural forms of these mechanisms. Specifically, when considering economic performance, we hypothesized that there will be an inverted U-shaped curvature (non-substitutionary effect) along the asymmetry line ( $H_{1b}$ ). In finding strong support for this hypothesis, we find that EC and EE cannot substitute for each other when it comes to economic performance. In other words, we bring to light that "too much of a good thing" could be a recipe for economic performance failure. Specifically, focusing on a single mechanism is not advisable as "it can blind managers and tether their organizations to a confining set of skills, concerns, and environmental states" (Miller, 1993, p. 130). Following this notion of "single-mindedness", our results suggest that high levels of either transactional mechanisms or relational mechanisms could hurt the generation of relational rents in a purely economic sense.

Alternatively, while considering environmental and social performance, we hypothesized that EE and EC can function as substitutes. In other words, we proposed that whenever EC and EE are at moderate levels the relationship will be characterized by mixed signals, which could in turn have a detrimental effect on the outcome variables (Granovetter, 1985; Lado et al., 2008). Interestingly, both these hypotheses ( $H_{2b}$  and  $H_{3b}$ ) were not supported, suggesting that EC and EE

cannot substitute for each other and that the moderate levels of EC and EE need not characterize mixed signals to the exchange partners. Instead, given the fact that behavioural uncertainty is comparably high, even moderate levels of EC seem to be sufficient to foster necessary cooperation between the partners insofar as it can negate any psychological barrier perceived due to the simultaneous adoption of EE. In other words, our result clearly shows that EC and EE cannot act as substitutes when considering environmental and social performance.

Additionally, while using unbalanced environmental supply chain mechanisms (substitutionary effect), our results show that the level of environmental and social performance is higher when EC is high and EE is low than when EC is low and EE is high. In fact, when transactional mechanisms are high and relational mechanisms are low, the outcome measures are at a low level, suggesting that the simultaneous reduction in transactional mechanisms and improvement in relational mechanisms is conducive to these outcome measures. Though past management literature suggests that transactional mechanisms such as monitoring could provide effective control over moral hazards (e.g., Williamson, 1985; Genctürk and Aulakh, 2007), it seems that they are less effective within the environmental management context owing to high behavioral uncertainty and performance ambiguity (e.g., Wathne and Heide, 2000). On the contrary, as relational mechanisms are rooted in the norms of trust, commitment, as well as, solidarity and flexibility, they seem to inculcate partner behavior that is directed more towards maintaining the relationship over a period of time, jointly developing new environmentally-friendly products and processes, and identifying new ways to use each other's strengths for the benefit of both parties. Accordingly, unlike EE, EC seems to have the unique ability to create a "clan" structure, which can facilitate an exchange relationship that is based on legitimate authority and mutual goals, thereby eliminating the need for explicit control mechanisms (Ouchi, 1980). In summary, given that environmental and social performance measures are concerned about the



holistic improvements in the environmental prowess of the firm, it seems that when environmental supply chain mechanisms are adopted in an unbalanced fashion, relational mechanisms are a better alternative to transactional mechanisms.

Our findings pertaining to the substitutionary effects provide novel insights on the plural forms of EC and EE given that extant empirical research has not examined it. Additionally, the use of response surface methodology also helps us to provide a more nuanced explanation of the effects of plural forms. Specifically, it gives us the ability to compare configurations of high EC / low EE as well as low EC / high EE to that of high EC / high EE using a 3-dimensional surface map (Tachizawa et al. (2012) compare only a low collaboration / high evaluation configuration to that of high collaboration / high evaluation). Apart from complementarity, this comparison brings forth two further implications: First, even though EC and EE are complementary in nature, a close observation of Figures 3 and 4 suggests that high EC / low EE can in itself help in achieving higher levels of environmental and social performance; Second, when considering all aspects of the triple bottom line performance, complete complementarity (i.e., high EC and high EE) need not be the best configuration. Instead, somewhere between moderate to high EC and EE (along the symmetry line) will result in the highest levels of all triple bottom line performance dimensions.

### **Managerial Implications**

Considering EC and EE in isolation can not only lead to waste of resources, but even diminish the performance effects of these mechanisms. Our study therefore provides managers with clear insights into when supplier management practices can act in a complementary fashion. The good news for managers is that no matter which aspects of TBL performance measure they prioritize (i.e., environmental, social or economic performance), higher levels of EC and EE will always lead to higher performance. Therefore “trust, but verify” approaches are the most adequate as complementary mechanisms are in place. Accordingly, firms should not only collaborate with

suppliers, but also implement audits and controls at the same time. The fear that a high level of controls can dissipate trust is not relevant in this scenario.

Unfortunately, firms often do not have the internal resources for such a high level of sustainability activity. Our results clearly indicate that firms should make a clear decision in such cases. If environmental and social performances are highly valued, EC practices should be implemented more strongly than EE practices as this provides best performance outcome. Most importantly, firms need not avoid situations where EE and EC are implemented at medium levels assuming that this could send mixed signals to suppliers and their performance could subsequently diminish. At the same time, it is important to understand that while adopting medium levels of EE and EC is preferable than having high levels of EE and low levels of EC, its performance is lower when compared to adopting high levels of EC and low levels of EE. In summary, when taken together, these recommendations provide a very clear guidance to managers on how much investment they should allocate to sustainability practices along their supply base so as to capture optimal performance benefits.

### **Limitations and Future Research**

First, though this study includes EC and EE as dimensions of transactional and relational mechanisms respectively, we believe that future research could extend this study by considering other transactional and relational mechanisms within the domain of environmental management. Second, this study focused only on the supply-side environmental mechanisms. Future research should also consider including transactional and relational mechanism from the customer perspective as well. Third, our analysis was based on subjective responses from survey respondents. In spite of the various survey design steps taken, subjective responses might induce biases, specifically for dependent performance variables. Therefore, we recommend future research to explore our hypothesized relationships by incorporating objective measurements for

performance and other key variables in our model. Fourth, though a wide range of industries were included in the final sample, the sampling frame consisted of only the ISM members within the USA. Additionally, though the sample size was sufficient, a larger sample could increase our result's generalizability. Accordingly, we suggest that future research replicate our study using a larger sample involving domestic as well as international respondents. Finally, the hypothesized relationships were evaluated using cross-sectional data. But the combined effects of EC and EE could be better explained using longitudinal data. In spite of these limitations, we believe that our study makes invaluable scholarly contribution on the complementary effects of EC and EE.

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**Table 1**  
Measurement instrument for environmental practices

Indicator (Cronbach's alpha, composite reliability, average variance extracted)	Standard coefficient <sup>‡</sup>
<b>Environmental collaboration</b> ( $\alpha = 0.95$ ; $CR = 0.95$ ; $AVE = 0.76$ )	
We cooperate with our suppliers to achieve environmental objectives.	0.84
We provide our suppliers with design specification that include environmental requirements for purchased items.	0.88
We encourage our suppliers to develop new source reduction strategies.	0.82
We cooperate with our suppliers to improve their waste reduction initiatives.	0.87
We work with our suppliers for cleaner production.	0.89
We collaborate with our suppliers to provide materials, equipment, parts, and/or services that support our environmental goals.	0.93
<b>Environmental evaluation</b> ( $\alpha = 0.94$ ; $CR = 0.94$ ; $AVE = 0.85$ )	
We conduct regular environmental audits into our suppliers' internal operations.	0.88
We periodically evaluate our suppliers' environmentally friendly practices.	0.97
We make site visits to suppliers' premises to help them improve their eco-performance.	0.91
We encourage our suppliers to get their ISO14000 certification. *	
Model fit indices: Normed Chi-Square (NC) = 2.32 ( $\leq 3.0$ ); Non-Normed Fit Index (NNFI) = 0.98 ( $\geq 0.90$ ); Comparative Fit Index (CFI) = 0.99 ( $\geq 0.90$ ); Root Mean Square Error of Approximation (RMSEA) = 0.096 ( $\leq 0.10$ ); Root Mean Square Residual (RMSR) = 0.03 ( $\leq 0.08$ ). Note: * items dropped during instrument development process; <sup>‡</sup> All loadings are significant at $p < 0.01$ Level	

**Table 2**  
Measurement instrument for performance measures

Indicator (Cronbach's alpha, composite reliability, average variance extracted)	Standard coefficient <sup>‡</sup>
<b>Economic performance</b> ( $\alpha = 0.84$ ; $CR = 0.81$ ; $AVE = 0.47$ )	
Decrease in cost of materials purchased.	0.62
Decrease in cost of energy consumption.	0.68
Decrease in fee for waste discharge.	0.61
Improvement in return on investment.	0.75
Improvement in earnings per share.	0.73
<b>Environmental performance</b> ( $\alpha = 0.92$ ; $CR = 0.92$ ; $AVE = 0.69$ )	
Reduction in air emission.	0.87
Reduction in waste (water and/or solid).	0.86
Decrease in consumption of hazardous/harmful/toxic materials.	0.75
Decrease in frequency for environmental accidents.	0.80
Increase in energy saved due to conservation and efficiency improvements.	0.85
<b>Social performance</b> ( $\alpha = 0.92$ ; $CR = 0.91$ ; $AVE = 0.68$ )	
Improvement in overall stakeholder welfare or betterment.	0.77
Improvement in community health and safety.	0.76
Reduction in environmental impacts and risks to general public.	0.94
Improvement in occupational health and safety of employees.	0.78
Improved awareness and protection of the claims and rights of people in community served.	0.84
Model fit indices: NC = 1.56 ( $\leq 3.0$ ); NNFI = 0.96 ( $\geq 0.90$ ); CFI = 0.97 ( $\geq 0.90$ ); RMSEA = 0.06 ( $\leq 0.10$ ); RMSR= 0.07 ( $\leq 0.08$ )	



**Table 3**  
Correlation between theoretical constructs and between theoretical constructs and control variables

Factors	Mean	S.D.	EC	EE	ECP	ENP	SOP
Environmental collaboration (EC)	4.097	1.436	<b>0.87<sup>a</sup></b>				
Environmental evaluation (EE)	3.359	1.640	0.73 <sup>b</sup>	<b>0.92</b>			
Economic performance (ECP)	4.653	1.166	0.35	0.41	<b>0.69</b>		
Environmental performance (ENP)	4.918	1.328	0.54	0.44	0.55	<b>0.83</b>	
Social performance (SOP)	4.939	1.208	0.52	0.43	0.63	0.67	<b>0.82</b>
<b>Control variables</b>							
Number of employees (EMP)	0.483	0.501	0.11	0.10	0.07	0.10	0.07
Annual sales volume (SAL)	0.662	0.475	0.09	0.18	0.03	0.04	0.06

<sup>a</sup> The square root of the construct's AVE is provided along the diagonal (given in bold).  
Off-diagonal numbers are the Pearson correlation between the constructs.

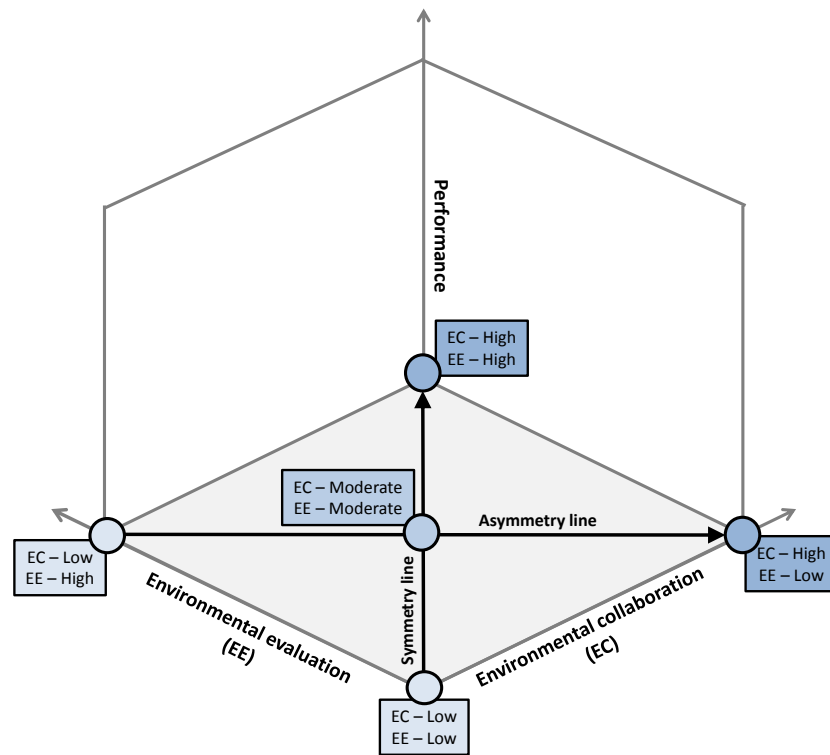
**Table 4**  
Regression results

		<b>Dependent</b>		
		<b>ECP</b>	<b>ENP</b>	<b>SOP</b>
EC		0.124	0.425 <sup>**</sup>	0.348 <sup>**</sup>
EE		0.200 <sup>*</sup>	0.105	0.081
EC <sup>2</sup>		-0.088	0.078	-0.018
EC*EE		0.174 <sup>*</sup>	-0.111	0.001
EE <sup>2</sup>		-0.099 <sup>*</sup>	0.018	0.028
Shape along the symmetry line	b <sub>1</sub> + b <sub>2</sub>	0.324 <sup>**</sup>	0.530 <sup>**</sup>	0.429 <sup>**</sup>
	b <sub>3</sub> + b <sub>4</sub> + b <sub>5</sub>	-0.013	-0.015	0.011
Shape along the asymmetry line	b <sub>1</sub> - b <sub>2</sub>	-0.076	0.320 <sup>+</sup>	0.267
	b <sub>3</sub> - b <sub>4</sub> + b <sub>5</sub>	-0.361 <sup>*</sup>	0.207	0.009
No of observations (N)		145	145	145
F-value		7.45 <sup>**</sup>	12.26 <sup>**</sup>	10.42 <sup>**</sup>
Adjusted R <sup>2</sup>		0.18	0.28	0.25

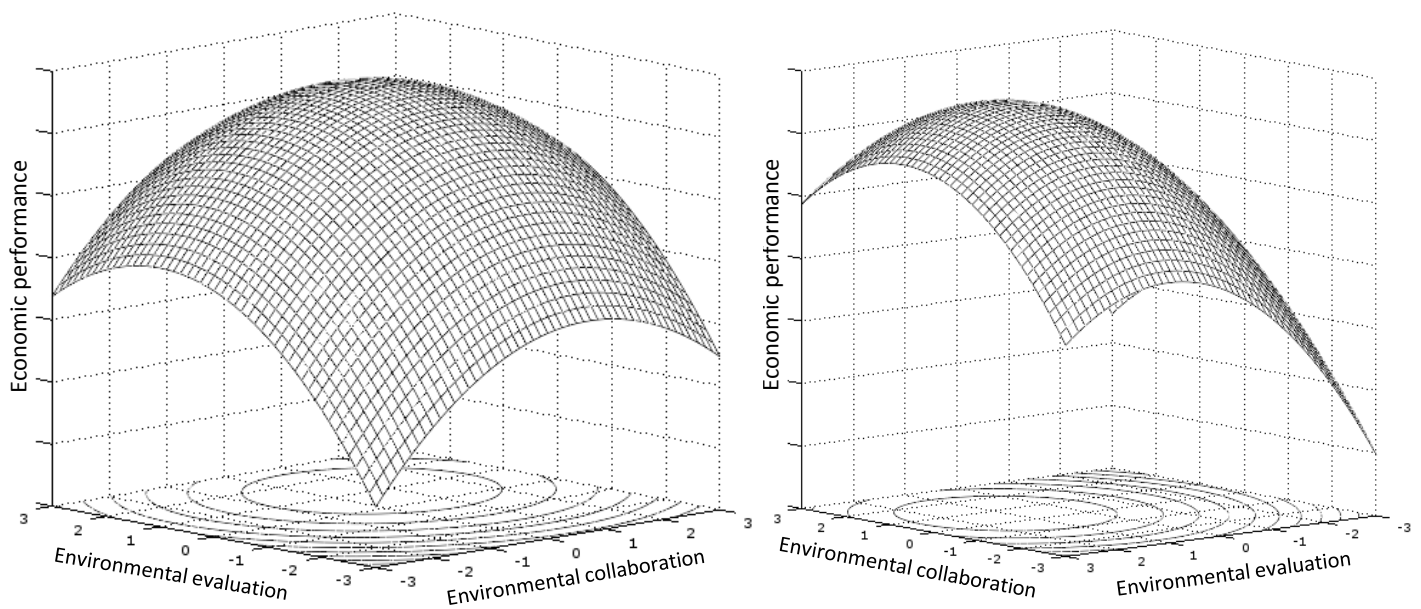
<sup>a</sup> Non-economic performance - Second-order factor including environmental and social performance.

<sup>\*\*</sup> significant at  $p \leq 0.01$ ; <sup>\*</sup> significant at  $p \leq 0.05$ ; <sup>+</sup> significant at  $p \leq 0.10$

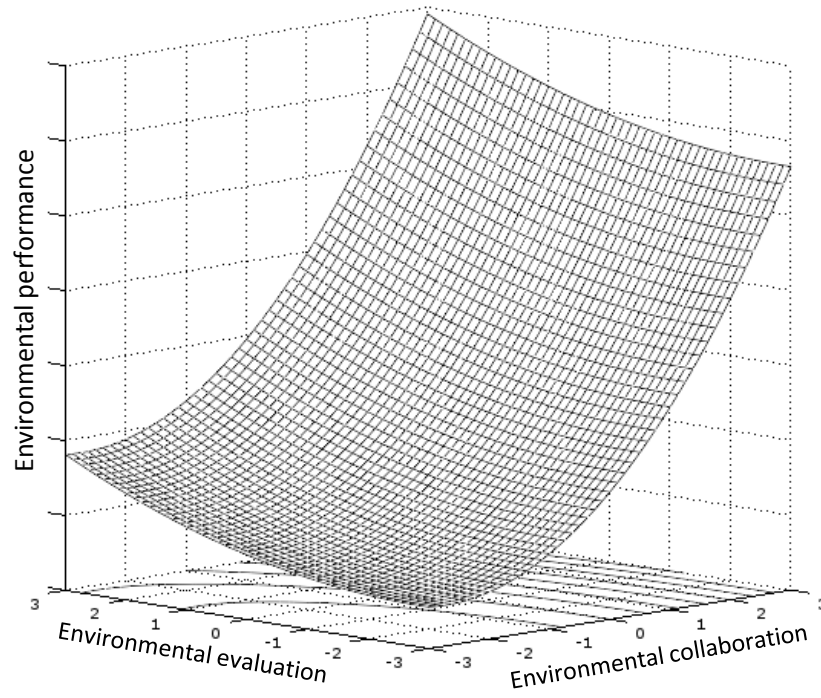
**Figure 1**  
Response surface - symmetry and asymmetry lines.



**Figure 2**  
Joint effects of EC and EE on economic performance.



**Figure 3**  
Joint effects of EC and EE on environmental performance.



**Figure 4**  
Joint effects of EC and EE on social performance.

